#### Programming Assignment 3: SDN and Ryu

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#### 1 Prerequisite

I have used ubuntu-18.04 as my operating system. I had installed mininet and ryu for this assignment. python and ryu-mnager have been used for running

#### 2 Part 1(Controller Hub) How to run

Open a terminal and run ryu-manager controllerhub.py Then open another terminal and change to root user and run python mininetpart1.py

#### 3 Part 1(Controller Hub) Design strategy

The Controller hub always broadcasts all the packets it receives at each port. Similarly my code contained at controller hub.py contains a class Controller Hub. It has method called function for switch. It configures the behaviour of the switch. It also has function for packet method it is invoked upon receiving any packet. It receives the packet and broadcast it to its all ports.

## 4 Part 1(Controller Hub) Ping and Throughput

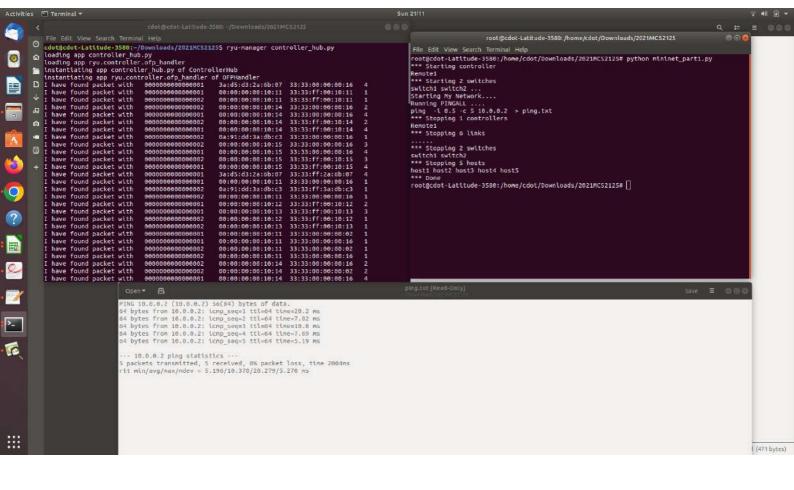
In controller hub the ping taking higher time and the throughput is less. Whereas in learing switch, first packet takes higher time but after that the ping time gets low because the switch stops broadcasting for the same port as it has learned the port vs node mapping. The throughput in learning switch is also higher beacuse lack of flooding the same message.

## 5 Part 1(Controller Hub) Output

I have executed ping from host 1 to host 2, 5 times with 0.5 sec gap following is the output

PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data. 64 bytes from 10.0.0.2: icmp seq=1 ttl=64 time=20.2 ms 64 bytes from 10.0.0.2: icmp seq=2 ttl=64 time=7.82 ms 64 bytes from 10.0.0.2: icmp seq=3 ttl=64 time=10.8 ms 64 bytes from 10.0.0.2: icmp seq=4 ttl=64 time=7.69 ms 64 bytes from 10.0.0.2: icmp seq=5 ttl=64 time=5.19 ms

— 10.0.0.2 ping statistics — 5 packets transmitted, 5 received, 0percent packet loss, time  $2004 \mathrm{ms}$  rtt min avg max mdev =  $5.196\ 10.370\ 20.279\ 5.270$  ms



# Programming Assignment 3: SDN and Ryu(Part 1 Learning Switch)

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#### 1 Part 1(Learning Switch) How to run

Open a terminal and run ryu-manager leraningswitch.py Then open another terminal and change to root user and run python mininetpart1.py

#### 2 Part 1(Learning Switch) Design strategy

The Learning Switch initially broadcasts the packets for an unknown destination packet it receives first time and then it saves the mac to port mapping and then from then onwards it unicasts packets based on mac and port mapping. Similarly my code contained at learningswitch.py contains a class LearningSwitch. It has method called functionforswitch. It configures the behaviour of the switch. It also has functionforpacket method it is invoked upon receiving any packet. It receives the packet and broadcast first time to its all ports and then it stores the mac to port mapping and now on it unicasts for that mac id.

# 3 Part 1(Learning Switch) Ping and Throughput

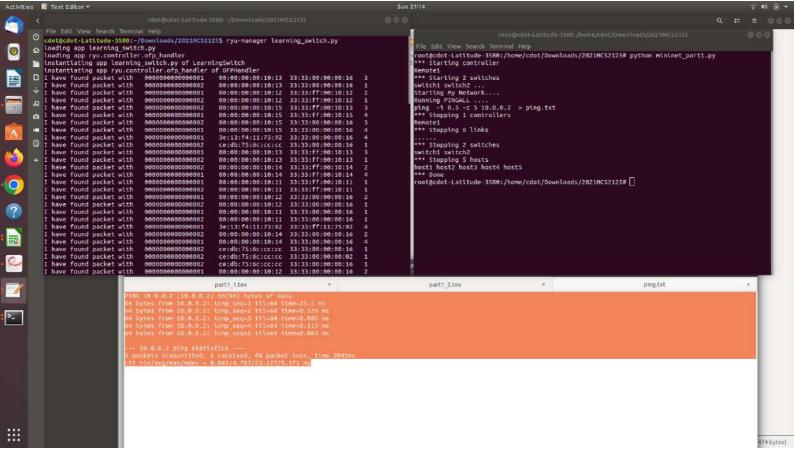
In Learning Switch first ping taking higher time and the throughput is less because first time it is broadcasting. Whereas afterwards after that the ping time gets low because the switch stops broadcasting for the same port as it has learned the port vs node mapping. The throughput in learning switch is also higher beacuse lack of flooding the same message.

#### 4 Part 1(Learning Switch) Output

I have executed ping from host 1 to host 2, 5 times with 0.5 sec gap following is the output

PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data. 64 bytes from 10.0.0.2: icmpseq=1 ttl=64 time=23.1 ms 64 bytes from 10.0.0.2: icmpseq=2 ttl=64 time=0.529 ms 64 bytes from 10.0.0.2: icmpseq=3 ttl=64 time=0.085 ms 64 bytes from 10.0.0.2: icmpseq=4 ttl=64 time=0.113 ms 64 bytes from 10.0.0.2: icmpseq=5 ttl=64 time=0.083 ms

— 10.0.0.2 ping statistics — 5 packets transmitted, 5 received, 0 percent packet loss, time 2041 ms rtt min avg max mdev = 0.083~4.787~23.127~9.171~ms



# Programming Assignment 3: SDN and Ryu(Part 2 Firewall Monitoring)

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#### 1 Part 2(Firewall Monitoring) How to run

Open a terminal and run ryu-manager firewall monitoring.py Then open another terminal and change to root user and run python mininet part2.py

#### 2 Part 2(Firewall Monitoring) Design strategy

The Firewall Switch initially apply all the rules intended for the packets it receives. Whenever it receives any packet and checks the action list and take appropriate action. Similarly my code contained at firewall monitoring py contains a class Firewall Switch. It has method called function for switch. It configures the behaviour of the switch. It also has function for packet method it is invoked upon receiving any packet. Upon receiving any packet, if the switch finds that the traffic is not allowed then it drops the packet...

## 3 Part 2(Firewall Monitoring) Rules

For all combination of souce and destination macm, firewall rules are applied. The number of rules can be decreased by using pattern based or regular expression based rule support.

## 4 Part 2(Firewall Monitoring) Output

I have executed ping from host1 to host2, 5 times with 0.5 sec gap This ping is successful because host1 and host2 are allowed to communicate. following is the output

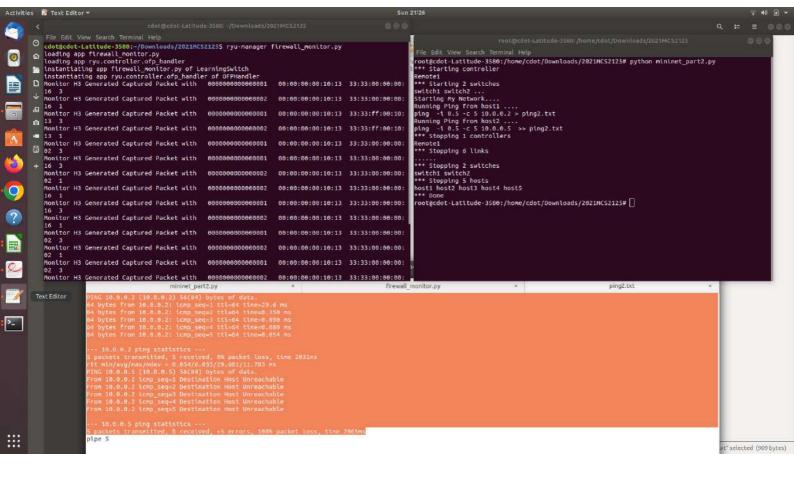
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data. 64 bytes from 10.0.0.2: icmp seq=1 ttl=64 time=29.6 ms 64 bytes from 10.0.0.2: icmp seq=2 ttl=64

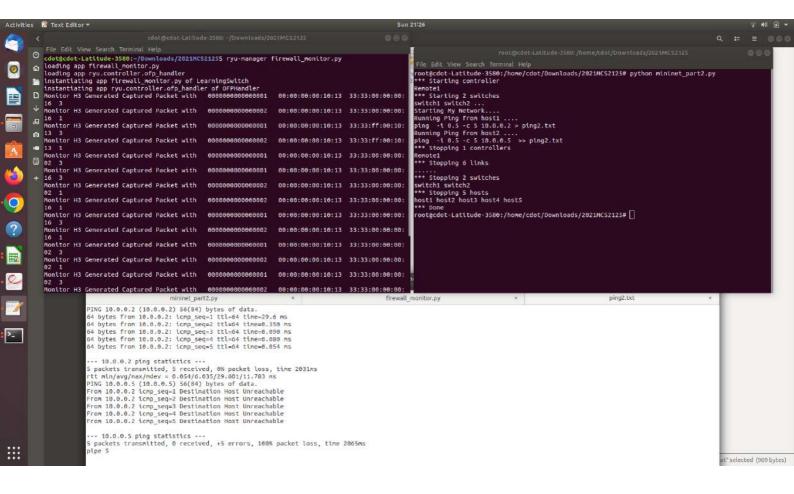
time=0.350 ms 64 bytes from 10.0.0.2: icmp seq=3 ttl=64 time=0.090 ms 64 bytes from 10.0.0.2: icmp seq=4 ttl=64 time=0.080 ms 64 bytes from 10.0.0.2: icmp seq=5 ttl=64 time=0.054 ms

- 10.0.0.2 ping statistics - 5 packets transmitted, 5 received, 0 percent packet loss, time 2031ms rtt min avg max mdev = 0.054 6.035 29.601 11.783 ms. Then I have executed ping from host2 to host5, 5 times with 0.5 sec gap This ping is unsuccessful because host2 and host5 are not allowed to communicate. following is the output

PING 10.0.0.5 (10.0.0.5) 56(84) bytes of data. From 10.0.0.2 icmp seq=1 Destination Host Unreachable From 10.0.0.2 icmp seq=2 Destination Host Unreachable From 10.0.0.2 icmp seq=3 Destination Host Unreachable From 10.0.0.2 icmp seq=4 Destination Host Unreachable From 10.0.0.2 icmp seq=5 Destination Host Unreachable

Since host2 and host5 has firewall blocking, hece ping has been blocked





# Programming Assignment 3: SDN and Ryu(Part 3 Load Balancer)

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#### 1 Part 3(Load Balancer) How to run

Open a terminal and run ryu-manager load balancer py Then open another terminal and change to root user and run python mininet part3.py

#### 2 Part 3(Load Balancer) Design strategy

The Load Balancer ditributes load in round robin fashion among target hosts. Whenever it receives any packet and checks last selected target and take a new target and send the packet toward it. Similarly my code contained at load balancer.py contains a class LoadBalancing. It has method called function for switch. It configures the behaviour of the switch. It also has function for packet method it is invoked upon receiving any packet. Upon receiving any packet, if swtch distributes the packet among host4 and host5.

## 3 Part 3(Load Balancer) Output

I have executed ping from host1 and host2 to 10.0.0.42, Each time a different target host was selected i.e. first time 10.0.0.4 and second time 10.0.0.5 was selected following is the output

Data Packet from ip: 10.0.0.1 Data Packet dest ip: 10.0.0.42 Selected Target Server ip is 10.0.0.4 Data Packet sent to: 10.0.0.4

Sending Reply from: 10.0.0.4 Sending reply to 10.0.0.1

Data Packet from ip: 10.0.0.2 Data Packet dest ip: 10.0.0.42 Selected Target

Server ip is 10.0.0.5 Data Packet sent to: 10.0.0.5

Sending Reply from: 10.0.0.5 Sending reply to 10.0.0.2

